Article by J. A. D. McCurdy, November 11, 1908

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Article written at Mr. Bells request for our Bulletin records. Hammondsport, 11 th -1908 Upon receipt of the following telegram from our chairman, on July 6th, designs were immediately got out preparatory to building the new A. E. A. No. 4: Pictou, N.S., July 6, '08. The Aerial Experiment Association, Hammondsport, N. Y.

If McCurdy wishes to follow on line of June Bug I recommend that McCurdy machine be now built at Hammondsport and headquarters be retained there for the present. In meantime, don't run any risk of injuring June Bug until an application for a patent has been prepared. Would like Baldwin to help me in Baddeck soon as possible and when we are ready for motor would like what information he may desire regarding machines built in Hammondsport. First bulletin of association will be issued from here Mondy, July 13th, giving you all full information as to what we are doing here. Please ask every member to write to me full account of what he is doing in Hammondsport. That information to be incorporated in succeeding bulletins to be issued every week in this way we can keep in touch with one another and incidentally secure written records of thoughts, ideas and work done. Trouble will be saved here by sending six copies of any drawings or photographs illustrating letters.

Graham Bell.

Experiments with the June Bug seemed to indicate that more powerful tip controls would be an advantage, (Fig. 1) especially in attempting to complete a turn and possibly describing a circle. To accomplish this end we gave the machine greater lateral extension t h an in the case of either of the former machines, (49 ft.) and also increased the area of the tip controls themselves, (40 sq.ft. total area.) Although it was conceded that a plane having the form of the letter S (roughly) in cross section was the form having the

greatest efficiency, as demonstrated by W. R. Turnbull of New Brunswick, we came to the conclusion that if a rib was 2 formed up being of single curvature, it would take the form of the Turnbull curve when acted upon by the air pressure as the machine glided through the air, if the rear was unrestricted and flexible, but if the rib was moulded with the double curve form the air pressure would bend it up abnormally at the rear and hence produce a detrimental effect.

We, therefore, decided to make up our ribs for the “Silver Dart” (as A.E.A. No. 4 was afterward named,) having the single curvature form. (Fig. 2) The depth of the planes was reduced at the center from 6 ft. 6 in. to 6 ft., and the distance between the planes consequently reduced in the same ratio, (6 ft. 6 in. to 6 ft ft.)

We designed the ends of the supporting plane to have a depth of 4 ft., as in former cases, and also to be 4 ft. apart. This re-proportioning gave the internal curve of the back edges an evener form and the machine as a whole finer lines. (Fig. 3 & 4.)

The fish shaped material used all through is of heavier stock and hence capable of greater rigidity of structure.

Turn buckles, (Fig. 5) shows fastening at top , and Fig. 6 that at bottom) are used on each individual wire, so that they can be separately adjusted to receive their proper strain. Two special instruments were devised; one as a tool for constructing the turn-buckle and the other a wrench to facilitate the screwing up of these turn buckles. (Fig. 7 and 8.)

The sockets used to connect the starts to the lateral chords are in their simplest form, doing away with the jack joint used on the June Bug. The projecting spike at the end of the socket passes through the straps to which the guy wires are secured and then into the hole prepared in the socket connecting the sections of the lateral chords. (Fig. 9 & 10.)

The tightening up of the turn buckles of the guy wires prevents these spikes from coming out. A single wire passing through the middle of the struts and connected by a V wire to both the top and bottom chord at the lateral extremities of the machine seems to answer the purpose of steadying the struts better than two wires, as in former cases, and it also offers less head resistance. (See Fig. 1)

The cloth used to cover the ribs, etc., forming the supporting surface is similar to that used by Capt. T. S. Baldwin for his government balloons, although lighter in weight, (2 ozs. per square yard,) and having silk on only one side of the rubber coating. It forms a beautiful surface, rubber side down, and is easy to handle, and capable of being cemented, as ordinary rubber. The tip controls were covered by making the silk in the form of a triangular bag and drawing it on tightly over the frames, thus making an equally clean surface on the top and bottom.

As in the case of the June Bug, a steel tube rib is placed at the junction of each section and acts as a spreader for the lateral chords. (Fig. 11,12,13 and 14)

The control panel is made exceptionally strong for various reasons. The b ending moments are greatest there and also as the dead load is located at that point the racking strains tell more there than elsewhere. This panel is made up first and is complete in itself. The four wings when placed in position fit into projecting sockets from each side of this panel, and are secured in place by the same method employed throughout the structure, viz ; of attaching and tightening up the turn buckles. Thus the four wings can be readily removed without disturbing the central panel, engine, bed, propellor or running gear. Figures 15, 16, 17 and 18 show the various points of construction of the panel.

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The silk of the Silver Dart is made in sections corresponding to the panel where it is to be used, and laces to a steel rib at each end. Thus the whole machine, silk and all, is made in sections so as to facilitate in repair work, should we be unfortunate enough to have an

accident. The advantage of having the silk in sections in “ knockling down ” the machine is also apparent The ribs slide into pockets prepared on the silk—, from the rear passing under the back lateral chord and butting neatly against th e back edge of the front chord and are secured in place by square ti n caps which slip over the rear end. These caps, one for each rib, are strung on a wire which passes through a seam in the rear of the silk and is secured at its ends to the lateral margin of the aeroplane, and to the central panel, being drawn taut by means of a turn buckle. There are two of these wires to a plane, one for the port wing and one for the starboard.

The rudder used on the Silver Dart is of quite small dimensions (4 ft. high by 2 ft. deep) and is constructed, as far as the silk is concerned, similarly to the tip controls, i.e. covering made as a bag and drawn on over the frame work and laced at the top. As both sides of the rudder act at different times, this method gives them even resistance s . The rudder is placed 11 feet back from the rear lateral chord, and is supported simply by four hinged bamboos so constructed that by releasing two lateral guy wires the whole thing folds up flat against the rear of the planes. The rudder is operated by small wire cable connected to the tiller of the front wheel. (Fig. 19.) The bow control is double decked, rigidly constructed throughout and placed 15 feet forward of the front lateral chord. It is operated similarly to that used in the June Bug, by a direct bamboo rod at the rear end of which is the steering wheel. 5 Push the wheel forward, it depresses the machine; pull it back and the machine rises; turn it to port or starboard, and the machine obeys respectively, whether on the ground or in the air.

The front control measures 12 feet long by 28 inches wide and 30 inches between the planes. It is supported five inches back from its front edge by a bamboo cantilever truss, as shown by figure 4.

It was our original intention to carry two persons in the Silver Dart, one sitting directly behind the other, Hence a seat was designed for the purpose and made adjustable so that it could be slipped forward and backward readily in balancing up the machine. The second

man would sit directly over the theoritical center of pressure at our travelling speed, so that the carrying of the passenger on leaving him behind would not affect the balance. The tips are controlled by a device which does not interfere with the man sitting behind the operator, and the device is also adjustable with the seat. (Fig. 3)

The pole connecting the steering wheel to the front control can be lengthened out or shortened in determining where the operator shall sit, by means of a telescopic tube which can be secured at any desired point.

The running gear or truck is almost the same as that used in the June Bug. There are improvements of construction and the material is heavier. (Fig. 20.)

The engine used was especially built for the Silver Dart and is a Curtiss eight cylinder, water cooled 50 h.p. motor, (See Bulletin 26 XVI) which weighs without water or oil, but including all water connections and counter shaft, 202 pounds. It is placed into its bed immediately on top of the lower rear lateral 6 chord, and braced directly from the stringers of the truck. (See Fig. 3 & 4). Its being placed so low will produce less strain on the structure in landing and will bring the center of gravity of the machine, as a whole, a little lower than in the case of the June Bug.

The radiator is designed somewhat after that used by the Wright Brothers, (See Fig. 4) and the gasoline and oil tank (one tank having a partition) holds 10 and 2 gallons, respectively.

The propellers used are of different designs and are driven by chain drive in the ratio of 1-½ to 1. (Engine turning 1500 revolutions and the propeller turning 1000). One propeller is used, and the thrust comes about through the line of resistance of the machine, but inclined above the horizontal 3 ¼ degrees. These are made of laminated wood and weigh, including the two clamps, 8 ¼ pounds; of 8 ft. diameter and 17 to 18 degrees pitch at the tip.

The supporting surfaceof the machine are given an angle of attack of 9 ¼ degrees at their lateral margins. This angle is excessive for economical flights, but it facilitates rising from the ground. After the machine is in the air, the angle will be reduced to perhaps 6 degrees.

It is for this reason that the propeller thrust is a little above the horizontal when the machine is on the ground. The proper angle at which to place the counter shaft for propeller can only be determined by actual experiment.

The actual work of construction of the Silver Dart was under the supervision of our foreman, Mr. Kenneth Ingraham, and too much cannot be said in his praise for the care taken by him in the detail work and in generally rushing the assembling to a successful finish.

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All the structural members of the Silver Dart, fish struts, wires, tubing, bamboo, etc., were carefully measured and in accordance with the method and co-efficients used by Mr. Octave Chanute the head resistance of the machine was computed and reduced to its equivalent flat surface in square feet.

All figures in square inches.

FISH SHAPED MATERIAL. NON VIBRATING WIRE VIBRATING WIRE. Wings 1928.6 976.89 131.30 Struts 1088.0 Additional fish 326.0 3342.6 TUBING TIMBER BAMBOO 668.00 365.5 345.0 DESCRIPTION SQ. INCHES. CO-EFF. EQUIV. SURFACE. Fish shaped 3342.50 # 557.08 Non Vib. Wire 976.59 ½ 488.44 Vir. Wire 131.30 1.6 198.95 Tubing 668.00 ½ 354.00 Timber 365.50 1 366.50 Bamboo 490.00 ½ 245.00 Total 2188.97

Hence the total hand resistance — 2138. 9 7 sq. in. or 15.10 sq. ft.

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DATA.

Total area of supporting surfaces 420 sq. ft.

Weight of machine, exclusive of engine and accessories, 345 lbs.

Weight of engine, propeller and counter shaft, etc., 210 “

Weight of radiator 15 “

Weight of water 30 “

Weight of gasoline, oil and tank, full 110 “

Weight of man, say 150 “

Total 860 lbs.

and as 860/420 = 2.04

Hence ratio equals 2.04 pounds per sq. ft.

i.e., flying weight = 2.04 lbs. per sq. ft.

John Curdy All the figures refered to nice appear in a following Bulletin.